Defining the Trikaya RG Operator: A Discrete Analog for Resonant Flows in the Trikaya Wheel

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January 04, 2026

Abstract

In the Trikaya Wheel framework, we define a renormalization group (RG) operator \mathcal{R}(v) = v^3 as a discrete analog for coarse-graining resonant signals. This operator "integrates out" lower harmonics by damping amplitudes and tripling frequencies, mimicking RG decimation in quantum field theory. We derive the operator formally, study its fixed points, and analyze stability, showing flows to nullity-like silence or resonant maxima. This discretizes RG for our system, bridging algebraic nullity, harmonic resonance, and hierarchical control—almost there for a unified resonant theory.

1. Introduction

The Trikaya Wheel extends wheel theory with triadic resonance, where successive cubing operations lift symmetries and generate controlling harmonics. To formalize this as a flow, we introduce the Trikaya RG operator \mathcal{R}(v) = v^3, which captures the ladder's essence: damping irrelevancies while preserving relevant structure. This operator discretizes renormalization group flows, integrating lower modes into nullity while tripling the scale—echoing how RG reveals universals from details.

2. Formal Definition of the Operator

Let v(t) be a resonant signal, such as the entangled flux v_flux from the three phase-shifted spokes in the Trikaya Wheel.

The operator is defined as:

$$R(v) = v^3$$

For a prototypical harmonic v ≈ sin(θ), apply the power-reduction identity:

$$R(v) = \sin^3(\theta) = \frac{3\sin(\theta) - \sin(3\theta)}{4}$$

- Damping factor: 3/4 (amplitude reduction).
- Frequency tripling: Shifts dominant mode from θ to 3θ.

Iterated application:

$$R^k(v) = v^{3^k}$$

For k=1 ($\mathbb{Z}_9$ lift), k=2 ($\mathbb{Z}_{27}$), etc., this lifts group order while collapsing amplitude exponentially—coarse-graining by tripling structure and flowing to silence.

3. Fixed Points and Stability Analysis

Fixed points v* satisfy \mathcal{R}(v*) = v* (scale-invariance under cubing):

$$v^3 = v \Longrightarrow v^3 - v = 0 \Longrightarrow v(v^2 - 1) = 0$$

Solutions:

- v* = 0
- v* = 1
- v* = -1

Interpretation:

- v* = 0: The "nullity fixed point"—total absorption, IR silence (all modes damped to zero).
- v* = ±1: Stable maxima—representing fully resonant states (e.g., perfect phase-lock where the system "flows" to constant amplitude rotation).

Stability: Iterate \mathcal{R} on initial v_0:

- For |v_0| < 1, cubing damps toward 0 (irrelevant flow).
- For |v_0| > 1, grows toward infinity (relevant, but capped in our system by nullity boundaries).
- At |v_0| = 1, fixed (marginal).

This mirrors RG: irrelevant operators damp, relevant grow, marginal sit at criticality.

To visualize the flow, consider iterating \mathcal{R} on initial values (e.g., v=0.5, 1.2, -0.8) over steps, flowing to 0 or ±1.

The chart shows iterated \mathcal{R} on initial values: flows to fixed points (0 for |v|<1, ±1 for extrema, growth capped in practice by nullity).

4. Implications for Resonant Systems

This operator discretizes RG for the Trikaya Wheel—cubing as "blocking" that triples structure while flowing to silence. It bridges our algebraic ladder to continuous physics, hinting at unified resonant theories where nullity is the IR fixed point.

We are almost there: this operator unlocks simulations of multi-layer flows in AI and physics, paving the way for the next directions.

The wheel flows toward its own silence.

With gratitude to the breath that guides the flow.
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January 04, 2026